

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1 1. (Currently amended) A remote copy system, comprising:
2 first and second primary storage subsystems, the first primary storage subsystem
3 including a first primary volume, the second primary storage subsystem including a second
4 primary volume, the first and second primary volumes storing a plurality of write data in a given
5 order;
6 an intermediate storage subsystem coupled to the first and second primary storage
7 subsystems and configured to synchronously receive the write data from the first and second
8 primary storage subsystems, the intermediate storage subsystem including a write-order-
9 information provider that is configured to generate write-order information for the write data
10 received from the first and second primary storage subsystems, the ~~write~~-write-order information
11 being associated with the write data received from the first and second primary storage
12 subsystems, the ~~write~~-write-order information reflecting the given order of storage of the write
13 data in the first and second primary storage subsystems, wherein the intermediate storage
14 subsystem includes intermediate volumes defined as a consistency group within which data
15 integrity is guaranteed; and
16 first and second secondary storage subsystems coupled to the intermediate storage
17 subsystem and configured to asynchronously receive the write data from the intermediate storage
18 subsystem, the first secondary storage subsystem including a first secondary volume that is
19 configured to mirror the first primary volume of the first primary storage subsystem which is a
20 separate storage subsystem from the intermediate storage subsystem, the second secondary
21 storage subsystem including a second secondary volume that is configured to mirror the second
22 primary volume of the second primary storage subsystem which is a separate storage subsystem
23 from the intermediate storage subsystem, wherein the write data are stored in the first and second

24 secondary storage subsystems according to the write order information associated with the write
25 data as generated by the write-order-information provider of the intermediate storage subsystem
26 which is a separate storage subsystem from the first primary storage subsystem having the first
27 primary volume and the second primary storage subsystem having the second primary volume.

2. (Canceled)

1 3. (Original) The remote copy system of claim 1, wherein the write-order-
2 information provider is a counter that generates a sequence number to be attached to the write
3 data received from the primary subsystems.

1 4. (Original) The remote copy system of claim 3, wherein the intermediate
2 subsystem includes first and second intermediate volumes, the first intermediate volume being
3 configured to receive the write data from the first primary volume, the second intermediate
4 volume being configured to receive the write data from the second primary volume.

1 5. (Original) The remote copy system of claim 4, further comprising:
2 a valid counter provided in the intermediate subsystem, the valid counter being
3 configured to keep the highest sequence number of the write data that is ready to be validated for
4 copying at the secondary subsystems.

1 6. (Original) The remote copy system of claim 4, further comprising:
2 first and second primary bitmaps provided at the first and second primary
3 subsystems, respectively;
4 first and second intermediate bitmaps provided at the intermediate subsystem; and
5 first and second secondary bitmaps provided at the first and second secondary
6 subsystems, respectively,
7 wherein the first and second primary bitmaps are associated with the first
8 intermediate bitmap and the first and second secondary bitmaps are associated with the second
9 intermediate bitmap,

10 wherein the bitmaps are used during a resynchronization process to determine and
11 copy only data have been changed since suspension of mirroring of a paired volumes.

1 7. (Original) The remote copy system of claim 3, wherein the intermediate
2 subsystem including a journal volume to receive the write data from the first and second primary
3 subsystems.

1 8. (Original) The remote copy system of claim 1, wherein the first and
2 second primary subsystems are disk array units.

1 9 (Original) The remote copy system of claim 1, wherein the primary
2 subsystems are provided at a primary site and the secondary subsystems are provided at a
3 secondary site, the primary site including a primary host, the secondary site including a
4 secondary host,

5 wherein the secondary subsystems are configured to replace the primary
6 subsystems as primary storage areas if either the primary subsystems or the primary host
7 experiences failure or is taken off line.

1 10. (Currently amended) An intermediate storage subsystem provided in a
2 remote copy system and coupled to a plurality of primary storage subsystems and coupled to a
3 plurality of secondary subsystems, the intermediate storage subsystem comprising:

4 a first intermediate storage area configured to receive write data from at least one
5 primary subsystem which is a separate storage subsystem from the intermediate storage
6 subsystem, the write data being received synchronously from the at least one primary subsystem,
7 the first intermediate storage area defined as a consistency group with which data integrity is
8 guaranteed; and

9 a write-order-information provider configured to generate ~~write-write~~-order
10 information for the write data received from the at least one primary subsystem, the ~~write-write~~-
11 order information being associated with the write data,

12 wherein the ~~write~~ write-order information is used to store the write data in at least
13 one of the secondary subsystems which is a separate storage subsystem from the intermediate
14 storage subsystem, so that the at least one secondary subsystem mirrors the at least one primary
15 subsystem.

1 11. (Original) The storage subsystem of claim 10, wherein the first storage
2 area is configured to receive first and second write data from the at least one primary subsystem
3 in a given order, the first and second write data being provided with first and second write order
4 information, respectively, by the intermediate subsystem,

5 wherein the first and second write data are stored in the at least one secondary
6 subsystem according to the given order using the first and second write order information.

1 12. (Original) The storage subsystem of claim 10, wherein the write-order-
2 information provides is a counter configured to generate sequence numbers, the generated
3 sequence numbers being associated with the write data according to an order the write data are
4 received from the at least one primary subsystem.

1 13. (Original) The storage subsystem of claim 10, wherein the first storage
2 area is a journal volume that is configured to receive write data from the plurality of primary
3 subsystems.

1 14. (Currently amended) The storage subsystem of claim 10, further
2 comprising:

3 a second storage area,

4 wherein the plurality of primary subsystems including a first primary volume
5 provided in a first primary subsystem, and a second primary volume provided in a second
6 primary subsystem[.],

7 wherein the first and second storage areas are first and second intermediate
8 volumes, the first intermediate volume being configured to receive write data from the first

9 primary volume and the second intermediate volume being configured to receive write data from
10 the second primary volume,

11 wherein the first intermediate volume is configured to send the write data received
12 from the first primary volume to a first secondary volume provided in a first secondary
13 subsystem and the second intermediate volume is configured to send the write data received from
14 the second primary volume to a second secondary volume provided in a second secondary
15 subsystem.

1 15. (Original) The storage subsystem of claim 14, further comprising:
2 a valid counter provided in the intermediate subsystem, the valid counter being
3 configured to keep the highest sequence number of the write data that is ready to be validated for
4 copying at the secondary subsystems.

1 16. (Original) The storage subsystem of claim 14, further comprising:
2 first and second primary bitmaps provided at the first and second primary
3 subsystems, respectively;
4 first and second intermediate bitmaps provided at the intermediate subsystem; and
5 first and second secondary bitmaps provided at the first and second secondary
6 subsystems, respectively,

7 wherein the first and second primary bitmaps are associated with the first
8 intermediate bitmap and the first and second secondary bitmaps are associated with the second
9 intermediate bitmap,

10 wherein the bitmaps are used during a resynchronization process to determine and
11 copy only data have been changed since suspension of mirroring of a paired volumes.

1 17. (Original) The storage subsystem of claim 16, wherein the first and
2 second secondary volumes are configured to mirror the first and second primary volumes,
3 respectively,

4 wherein the write data are received from the primary subsystems at the
5 intermediate subsystem synchronously,

6 wherein the write data are transmitted to the secondary subsystem from the
7 intermediate subsystem asynchronously.

1 18. (Original) The storage subsystem of claim 10, wherein the intermediate
2 storage subsystem is a disk array unit.

1 19. (Currently amended) A method for operating a remote copy system, the
2 method comprising:

3 receiving first write data from a first primary storage subsystem at an intermediate
4 storage subsystem which is a separate storage subsystem from the first primary storage
5 subsystem, the first write data being sent by the first primary subsystem synchronously;

6 associating first write order information to the first write data at the intermediate
7 storage subsystem, the intermediate storage subsystem including intermediate volumes defined
8 as a consistency group within which data integrity is guaranteed;

9 receiving second write data from a second primary storage subsystem at the
10 intermediate subsystem which is a separate storage subsystem from the second primary storage
11 subsystem, the second write data being sent by the second primary subsystem synchronously;

12 associating second write order information to the second write data at the
13 intermediate storage subsystem;

14 transmitting asynchronously the first write data and the first write order
15 information to a first secondary storage subsystem which is a separate storage subsystem from
16 the intermediate storage subsystem; and

17 transmitting asynchronously the second write data and the second write order
18 information to a second secondary storage subsystem which is a separate storage subsystem from
19 the intermediate storage subsystem,

20 wherein the first and second write data are stored in the first and second
21 secondary subsystems, respectively, according to the first and second write order information.

1 20. (Original) The method of claim 19, further comprising:
2 receiving synchronously third write data from the first primary subsystem at the
3 intermediate storage subsystem, the third write data being received at the intermediate subsystem
4 after the first write data;
5 associating the third write data with third write order information;
6 transmitting asynchronously the third write data and the third write order
7 information to the first secondary subsystem,
8 wherein the first and third write data have the same destination address, the
9 destination address identifying a storage area in the first secondary subsystem,
10 wherein the first and third write order information is used to store the first write
11 data to the identified storage area prior to storing the third write data to the identified storage
12 area.

1 21. (Original) The method of claim 19, wherein the write order information is
2 sequence numbers, the method further comprising:
3 transmitting a request to prepare the first, second, and third write data for storage
4 in the first and second secondary subsystems, the prepare request being transmitted to the first
5 and second secondary subsystems from the intermediate subsystem, the prepare request
6 including a reference sequence number; and
7 transmitting a request to validate the write data that have been prepared according
8 to the prepare request, the validate request being transmitted to the first and second secondary
9 subsystem from the intermediate subsystem that identifies the write data to be prepared.

1 22. (Currently amended) A computer readable medium comprising a
2 computer program for operating a remote copy system, the computer program comprising:
3 code for receiving first write data from a first primary volume of a first primary
4 storage subsystem at an intermediate storage subsystem which is a separate storage subsystem

5 from the first primary storage subsystem, the first write data being sent synchronously by the
6 first primary subsystem;

7 code for associating first write order information to the first write data at the
8 intermediate storage subsystem, the intermediate storage subsystem including intermediate
9 volumes defined as a consistency group within which data integrity is guaranteed;

10 code for receiving second write data from a second primary volume of a second
11 primary storage subsystem at the intermediate subsystem which is a separate storage subsystem
12 from the second primary storage subsystem, the second write data being sent synchronously by
13 the second primary subsystem;

14 code for associating second write order information to the second write data at the
15 intermediate storage subsystem;

16 code for transmitting asynchronously the first write data and the first write order
17 information to a first secondary storage subsystem, the first secondary subsystem including a
18 first secondary volume which is a separate storage subsystem from the intermediate storage
19 subsystem; and

20 code for transmitting asynchronously the second write data and the second write
21 order information to a second secondary storage subsystem, the second secondary subsystem
22 including a second secondary volume which is a separate storage subsystem from the
23 intermediate storage subsystem,

24 wherein the first and second write data are stored in the first and second
25 secondary subsystems, respectively, according to the first and second write order information, so
26 that the first and second secondary volumes mirror the first and second primary volumes.

1 23. (Currently amended) An intermediate storage subsystem provided in a
2 distributed remote copy system, the intermediate storage subsystem comprising:

3 means for receiving write data from first and second primary volumes of first and
4 second primary subsystems which are separate storage subsystems from the intermediate storage
5 subsystem, the first primary volume being defined in the first primary subsystem, the second

6 primary volume being defined in the second primary subsystem, the write data being received
7 synchronously from the primary subsystems; and

8 means for generating write order information for the write data received from the
9 primary subsystems, the write order information being associated with the write data, the write
10 order information providing information as to a write order of the write data,

11 wherein the write order information is used to store the write data in the first and
12 second secondary volumes of first and second secondary subsystems which are separate storage
13 subsystems from the intermediate storage subsystem, the first secondary volume being defined in
14 the first secondary subsystem, the second secondary volume being defined in the second
15 secondary subsystem, wherein the intermediate storage subsystem asynchronously transmits data
16 to the first and second secondary subsystems,

17 wherein the intermediate storage subsystem includes intermediate volumes
18 defined as a consistency group within which data integrity is guaranteed,

19 wherein the first and second secondary volumes mirror the first and second
20 primary volumes.